

😊ELECTROMAGNETIC INDUCTION😊

Electricity and magnetism are related to each other.

Moving charges produces magnetic field.

😊 Phenomenon in which electric current is generated by varying magnetic field is known as **Electromagnetic Induction**.

It is the relative motion b/w the magnet and coil that is responsible for generation (induction) of electric current in the coil.

Relative motion b/w the coils that induces the electric current.

😊 **MAGNETIC FLUX:-** Number of magnetic lines crossing any closed surface area perpendicularly is known as magnetic flux.

$$\Phi = B.A = BA \cos \theta$$

SI unit- weber , tesla.meter², A Scalar quantity

*Applicable to non-uniform, plane and curved area.

😊 **Faraday law of induction-** An emf is produced when magnetic flux changes through the passing time.



☺ Faraday law of electromagnetic induction (NEWMAN'S Law) The negative rate of change of magnetic flux produces an emf in the circuit.

$$e = -N \frac{d\Phi_B}{dt}$$

N = Number of turns in the coil.....(-) means the direction of e and the direction of current in closed loop is opposite.

Induced emf can be increased by increasing the number of turns.

Unit- Volt, Weber/second

$N \Phi$ = Number of magnetic flux linkages. || Unit = weber-turns

*Change in flux = induced emf

|| Ways of changing emf ||

1. Changing B
2. Changing A
3. Changing the angle
4. Also by rotating the coil

If it is parallel then $\Phi = 0$ and if it is perpendicular then $\Phi = BA$

☺ Second law :- The direction of induced emf or induced current is as to oppose the source of its production i.e. magnetic flux. It is also called Lenz's Law.

It is in accordance with the conservation of energy.

***Direction of Induced current- Fleming's right hand rule { index finger-B, thumb - motion of conductor, middle finger - induced current }

☺ MOTIONAL ELECTROMOTIVE FORCE :- The emf Bvl is called motional emf.

Induced emf can be produced by changing motion of conductor .i.e. changing magnetic flux.

$$W = qvBl$$

$$E = Bvl \quad (E = W/q)$$

☺ EDDY CURRENT :- An undesirable current .

Methods to minimize-

- ✚ By using a lamination of metal to make metal core.
- ✚ Plane of lamination must be arranged parallel to magnetic field so that they cut across the eddy current path.
- ✚ Dissipation of elec. ene. into heat depends upon the square of the strength of electric current , heat loss is reduced.

ADVANTAGES —

- ❖ Magnetic braking in trains.
- ❖ Electromagnetic damping
- ❖ Induction furnace
- ❖ Electric power meter

☺ INDUCTANCE - $\Phi_B \propto I$

If geometry of coil does not vary with time ,

$$d\Phi/dt \propto dI/dt$$

$N\Phi \propto I$ ($N\Phi$ = magnetic flux linkage)

Here, the constant of proportionality is called inductance. It depends upon the geometry of coil and intrinsic material property. It is a scalar quantity .

Dimensions- $[ML^2 T^{-2} A^{-2}]$ unit= henry (H)

☺ MUTUAL INDUCTANCE- $N_1 \Phi_1 = M_{12} I_2$

M_{12} = Mutual inductance of solenoid S_1 wrt S_2 . It is also called coefficient of mutual induction.

$$N_1 \Phi_1 = \mu n_1 n_2 \pi r_1^2 l$$

$$N_2 \Phi_2 = \mu n_1 n_2 \pi r_1^2 l I_1$$

Relation b/w emf and M-

$$E = -M dI_2/dt \text{ (in C1 coil)}$$

☺ SELF INDUCTANCE:- denoted by L

$$N\Phi \propto I \ggg N\Phi = LI \ggg e = -N d\Phi_B/dt$$

$$E = -L di/dt$$

$$L = \mu n^2 Al$$

$$\parallel L = \mu_0 \mu_r n^2 Al$$

☺ AC GENERATOR -

Principle- electromagnetic induction



